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though strange and unusual in exterior, so infrequently that they hardly claim our present attention. In the structure of their seed-vessels and seeds they are objects of curious interest and beauty, but require a quick eye to detect the condition favorable to secure specimens, which when collected, must be submitted to the microscope to satisfy the enquirer.

If our excursion and lesson has convinced us that in the distribution of plants, the ocean, which to many, shuts out the chance of minute observation, forms no exception to the law of vegetation; each part of its vast bosom bearing, like the earth, its appropriate flowers, plants and fruits, a day or two among the sea-weeds will be well employed.



FOOT-NOTES FROM A PAGE OF SAND.

BY DR. ELLIOTT COUES, U. S. A.



IF those whom fashion and the weather drive from city follies and vices to the vices and follies of the seaside; who live in hotels and carriages and fancy the society of their kind the only sort desirable or possible,—if such read at all by the sea shore, it is not from the broadest and most eloquent page before them. With eyes to see, blind; deaf, with ears to hear; to them, a blank, a void, beyond the titillation of social scandal. Others go out of doors afoot, looking and listening; in every object by their pathway a familiar thing; with every vibration of the air, a well known voice; with every odour a reminiscence. *Alone* by the sea? There is no solitude—no escape for the naturalist, even though in a weak moment he wish it, from a multitude—no disentangling of self from the web of animate creatures of which he is one slender thread.

The sea, we know, is teeming with life—full of shapes

useful or curious, beautiful or monstrous; the waves themselves, in ceaseless change, incessantly battling with the land, seem life-like; but the sand itself, solid and motionless, looks lifeless. The great broad sheet that stretches along the coast seems to be now, as it always has been, inanimate. A vast bed of silica; and yet if not alive, what a sarcophagus it is of myriad lives since perished! If the poet says of dust in the crack of a door, "Great Cæsar's ashes here!" and attach to the mote and the man common and equal significance, yet farther than this the naturalist; for him, not the greatest pile that ever rose over emperors' remains—not the pyramids,* tombs of Pharaohs, are so great, as this monument of life that Nature built—the simple sand. If ghosts be ever laid, here lie hosts, of creatures innumerable, vexing the mind in the attempt to conceive, never to compute, them; so minute that a grain of sand is prodigious beside. Creatures of wonderful, beautiful, varying shapes; creatures that ate and drank after their fashion and went on rejoicing or grieving till the day came. Let us write a name in the sand; the wave comes—the ebb, the cradle,—the flow, the grave—of such short-lived creatures; what to these then, that write their name in the "sands of time;" the coast of a continent their grave, the beach their monument, each sand-grain an epitaph.

How long this book has been making we do not know; no man's time will suffice him to turn and read even a single page. Reflection confounds; still we may stroll on, observant, if not thoughtful; a letter, a point, an intelligible note, may catch the eye; and trifles enough have at least some pith. Say, at the moment, there is no living thing in sight. As a wave curls away from the mirrored sand, little bubbles play here and there for a few moments, and then too subside. Under the sand, where each bubble rose, lives a creature,

*And these too, are of a sort of limestone, called "nummulitic" because chiefly composed of vast numbers of certain Foraminifers (*Nummulites*). An ounce of Foraminiferous sand is estimated to contain upwards of four millions of these protozoans.

encased in shell armour, rarely seen alive, and scarcely known except by its casement, when this is thrown upon the beach; what some call a razor-shell, others *Solen ensis*. When the foot presses in yielding sand, surcharged with moisture, a slender jet of water spirts up; below is a clam (*Mya arenaria*); it dislikes the weight upon its elastic home, and remonstrates. There goes a groove in the sand, as if a child had wantonly dragged its copper-toed boot along, or some curious share had turned as curious a furrow; but the creature that made it has gone below, after what would have seemed to us, had we witnessed it, a tedious journey. Scattered here and there are large globular, yet essentially spiral, shells of the sea-snail (*Neverita heros*); the animal that lives in them made that mark, unfolding a great fleshy "foot," and gliding along, perhaps eating something as it went, with an organ that is mouth and limb in one. Where it is now, under the sand, are plenty more mail-clad things, of all shapes and sizes and colors; snug and secure, giving no sign of their presence. The sand is not only a great closet of foraminiferous skeletons; it is full of flesh and blood.

But we may look for signs from above as well as under the earth, or from the waters beneath; the sand tattles many pleasant, harmless secrets, if we only attend. Here are foot-notes again, this time of real steps from real feet; the next tide will wash them out; but perhaps some one of them, — the one chance of millions — may be left to signal, centuries hence, as much as they tell now. They are wedge-shaped, and meaningless as the cuneiform characters upon a Babylonian obelisk, unless the key to the cryptogram is found; for this, the lock must first be examined to the last detail, and it is surprising how many details there are. The imprints are in two parallel lines, an inch or so apart; each impression is two or three inches in advance of the next one behind; none of them are in *pairs*, but each one of one line is opposite the middle of the interval between two of the

other line ; they are steps as regular as a man's, only so small. Each mark is fan-shaped ; it consists of three little lines less than an inch long, spreading apart at one extremity, joined at the other ; at the joined end, and *also* just in front of it, a flat depression of the sand is barely visible. So much : now following the track we see it run straight a yard or more, then twist into a confused ball, then shoot out straight ; again then stop, with a pair of the foot-prints opposite each other, different from the other end of the track, that begun as two or three little indistinct pits or scratches, not forming perfect impressions of a foot ; where the track twisted there are several little round holes in the sand. The whole track commenced and finished upon the open sand. The creature that made it could not, then, have come out of either the sand or the water ; as there are no fire-animals now days, it must have come down from the air ; a two-legged flying thing—a bird. To determine this, and next, what kind of bird it was, every one of the trivial points of the description just given must be taken into account.

It is a bit of autobiography ; the story of an invitation to dine, acceptance, a repast, an alarm at the table, a hasty retreat. A bird came on wing, lowering till the tips of its toes just touched the sand, gliding half on wing, half a foot, until the impetus of flight was exhausted ; then folding its wings, but not pausing, for already a quick eye spied something inviting ; a hasty pecking and probing to this side and that, where we found the lines entangled ; a short run on after more food ; then a suspicious object attracted its attention ; it stood stock-still (just where the marks were in a pair) till, thoroughly alarmed, it sprang on wing and was off. So much is perfectly plain and intelligible ; it may be not quite so easy to find out what the bird was, for we will shut the "back-stairs" door and allow no guessing, but go honestly about our induction, as if we only knew of dead birds in the closet, and had never seen a live one.

Each foot-print was of three marks only; clearly then made by a three-toed bird; or, if by one with four toes, the fourth was too short to reach and impress the ground visibly, or else was joined to the leg too high up. The three marks all point forward; then the hind toe, or *hallux*, as it is called, was the missing or rudimentary one. Now, unless the bird was of a kind unknown to naturalists, which is highly improbable, it must have belonged to one or the other of two groups—the Walkers and Waders, or the Swimmers—named, respectively, *Cursores* and *Natatores*, since no bird of the only other remaining group (*Insessores*) has none, or a rudimentary hind toe.* Birds, however, cannot swim unless their feet are fashioned into paddles of some sort. We only know of this being done in two ways: either by stretching a membrane between the toes, making a webbed foot, or by fringing of the toes by broad membranes, making a lobed foot. But either of these feet, pressing the glassy sand, would have shown its pattern. Clearly then the bird was neither palmiped or lobiped—it was not one of the *Natatores*; it must have been a Wader. Other reasoning, from a different premise, brings us to the same conclusion. The marks were not in pairs, but alternating, each with its fellow of the other line; the bird did not hop or leap, but walked or ran bringing one leg after the other, whence we legitimately infer that it was not one of *Insessores* or Perchers; for these hop. But it might be asked, how do we know that the perchers hop instead of walking when on the ground, since we are agreed that we never yet saw a live one to find out by observation? Yet it is easy to reason up to such a point, that assumption is virtual certainty. For the hind toe (or each hind toe when there are two) of the *Insessores* is long, is inserted on a level with the anterior ones, and is armed with a curved claw as the others are. This arrangement is

*To this and all other unqualified general statements in ornithology there are technical objections and real or apparent exceptions, not, however, invalidating general rules.

for the perfect opposition of the hind and front toes, as the thumb of our hand opposes the fingers; it infallibly suggests the idea of something to be clasped between—of grasping some object; the suggestion amounts to a moral certainty when we dissect and find among typical perchers a special muscle for the freer and more advantageous working of this hind toe in opposition to the others. Such birds then, live where their foothold is not upon a flat surface, as the ground, but upon slender, cylindrical, claspable supports, as are found in trees and bushes. But there cannot be much plain walking done among twigs; the birds must constantly spring from one to another branch, and when they happen to descend to the ground it is not likely they would at once change a habit inborn and inbred for ages. So with certain exceptions, not necessary to point out here, *Insessores* are hoppers, as distinctively as all birds below them are either Walkers or Swimmers.

This bird's wings never touched the sand, yet the marks show the shape of the wing as plainly as the character of the feet. The wings were flat, long, narrow and pointed, cutting the air like blades. We learn this from the few indistinct scratches on the sand just before the prints became perfect. The bird came gliding swiftly and low, and scraped the sand before its wings were closed; to do this requires a wing large or at least long. For all heavy bodied birds, or birds with wings small for their weight; or with short, rounded and concave wings—all these, however fast they may whirr along when fairly on wing, must drop quietly, if flying slowly, or arrest their motion abruptly and forcibly, if flying rapidly, to avoid shock on alighting; in either case they drop plump, and find their feet at once. Now of all our true walking or wading birds the *Gallinæ* (Grouse, Quail, etc.) and the *Paludicolæ* (Rails and Gallinules) conform to these last mentioned particulars; so does the Heron family, and these, moreover, have a long hind toe. It could have been neither of these. The circle of possibili-

ties is rapidly narrowing; we have only left whence to pick, the families of birds that make up the group *Limicolæ*, or the shore-waders, as distinguished from the *Paludicolæ*, or marsh-waders. Conning the *Limicolæ* over in mind, we find there are but two families furnishing in our locality any species so small that the imprint of its toes is less than an inch long. These are the Plover and the Snipe families (*Charadriidæ* and *Scolopacidæ*).

We noticed just in front of the point where the lines of the three toes came together—at the “heel,” as it is generally but wrongly called—that the depression of the heel-mark continued a slight distance between the bases of the toes. Clearly there must have been something of a web connecting the roots of the toes, just as our fingers are joined at the hand. Now our plovers and snipes each furnish us one, and only one, bird that is partially webbed and small enough to have made the tracks; these two are the Semipalmated or Ring Plover (*Ægialitis semipalmatus*) and the Semipalmated Sandpiper (*Ereunetes pusillus*); it might have been either, for anything we have yet noticed. Which was it? We have exhausted our foot-data, but still one mark is left, and that decides. The snipes have long bills, vascular, nervous, and sensitive at the tip; these are organs of touch; the birds *feel for* things they cannot see. The plovers have short bills, comparatively hard at the tip. There were little round holes in the sand, just where the lines tangled up; this was where the little bird stuck in its bill and probed for something. It would be useless for a plover to do this, for it could not *feel* anything if it did; we infer then, that a plover never would. And so at last, the bird stands confessed; Semipalmated Sandpiper, *Ereunetes pusillus*; section *Tringæ*, of family *Scolopacidæ*, of group *Limicolæ*, of order *Grallæ*, of subclass *Cursores*, of class *Aves* or BIRDS.